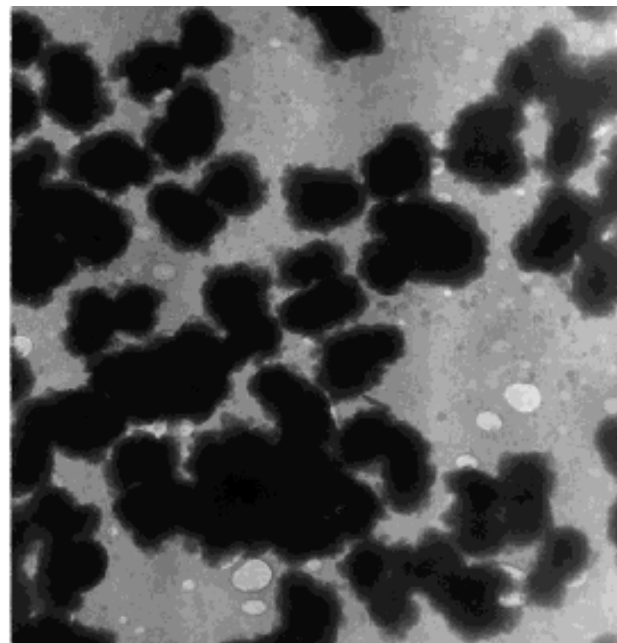


# **Size and Shape of Small Crystals Affect Surface Chemistry and Consolidation.**

## **Rational Synthetic Methods**

**K. J. Klabunde, Kansas State University, DMR-0234686**

Porous inorganic materials such as zeolites, high surface area carbon, mesoporous silicas, clays, and aerogels are of vital importance in industry and in environmental cleaning and remediation. Now a new family of such materials has been discovered based on the controlled aggregation of nanocrystals. These new mesoporous, low density solids, and the final structures are dependent on the gel structure, and so we term them Gelation Dependent Structures (GDS). They are highly versatile in chemical makeup, and can be basic or acidic, and have reactive surface sites due to unusual nanocrystal shape. GDS-MgO,  $\text{Al}_2\text{O}_3$ ,  $\text{TiO}_2$ , mixed oxides, such as GDS-MgO. $\text{Al}_2\text{O}_3$  and others are accessible, and the structures can be controlled by the dielectric constant of the solvent employed. No supercritical drying step is required, thus greatly simplifying synthesis and lowering cost.



GDS-MgO nanocrystal aggregates of MgO that can be used as a fine powder or can be compacted into high surface area mesoporous pellets

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### **Education:**

Two undergraduates, Peter J. Pauzauskie (Goldwater scholar, currently a graduate student at UC-Berkeley) and Molly Martin, REU student from Augustana College, (now a graduate student at U. of Iowa); two graduate students, David Heroux (Ph.D. 2004, now Asst. Prof. at U. Maine) and Gavin Medine (Ph.D., 2004); and one Post-doctoral Associate, Ranjit Koodali, have been involved in this work. Medine and especially Heroux, were very active at K-State in National Chemistry Week and in presenting chemistry magic shows at elementary, middle, and high schools and various functions throughout Kansas.

### **Outreach:**

**Commercialization:** The P.I. is the founder and a consultant for a private company, Nanoscale Materials, Inc., currently with 35 employees. This company markets reactive porous materials under the trademark Nanoactive™, including an assortment of metal oxide powders, granules, and slurries as well as FAST-ACT, a patented device/formulation for protecting soldiers, emergency responders, fireman, police officers and laboratory workers from toxic chemical spills, including chemical warfare agents. Nanoscale's technology is partly based on fundamental research funded by NSF in the P.I.'s laboratories.



**Nanoscale Materials, Inc. Corporate Facilities in Manhattan, Kansas**